

FIG 1

LISP S-expression

102

$(+ (* 5 (\text{sqrt } 4)) (/ 63))$

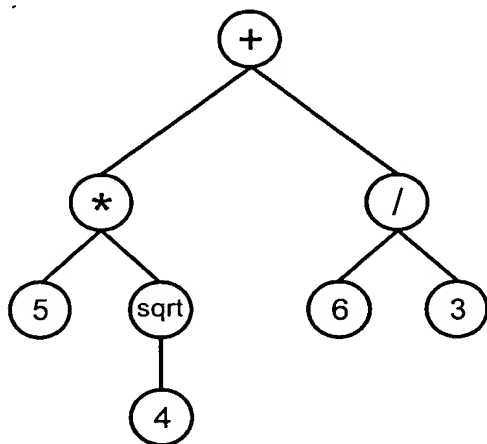
Conventional mathematical expression

101

$5 \cdot \sqrt{4} + \frac{6}{3}$

Tree representation

103



Coding region of a chromosome
of the present invention

104

+*/5Q634

105

00992207001
T09070"28266860

FIG 2

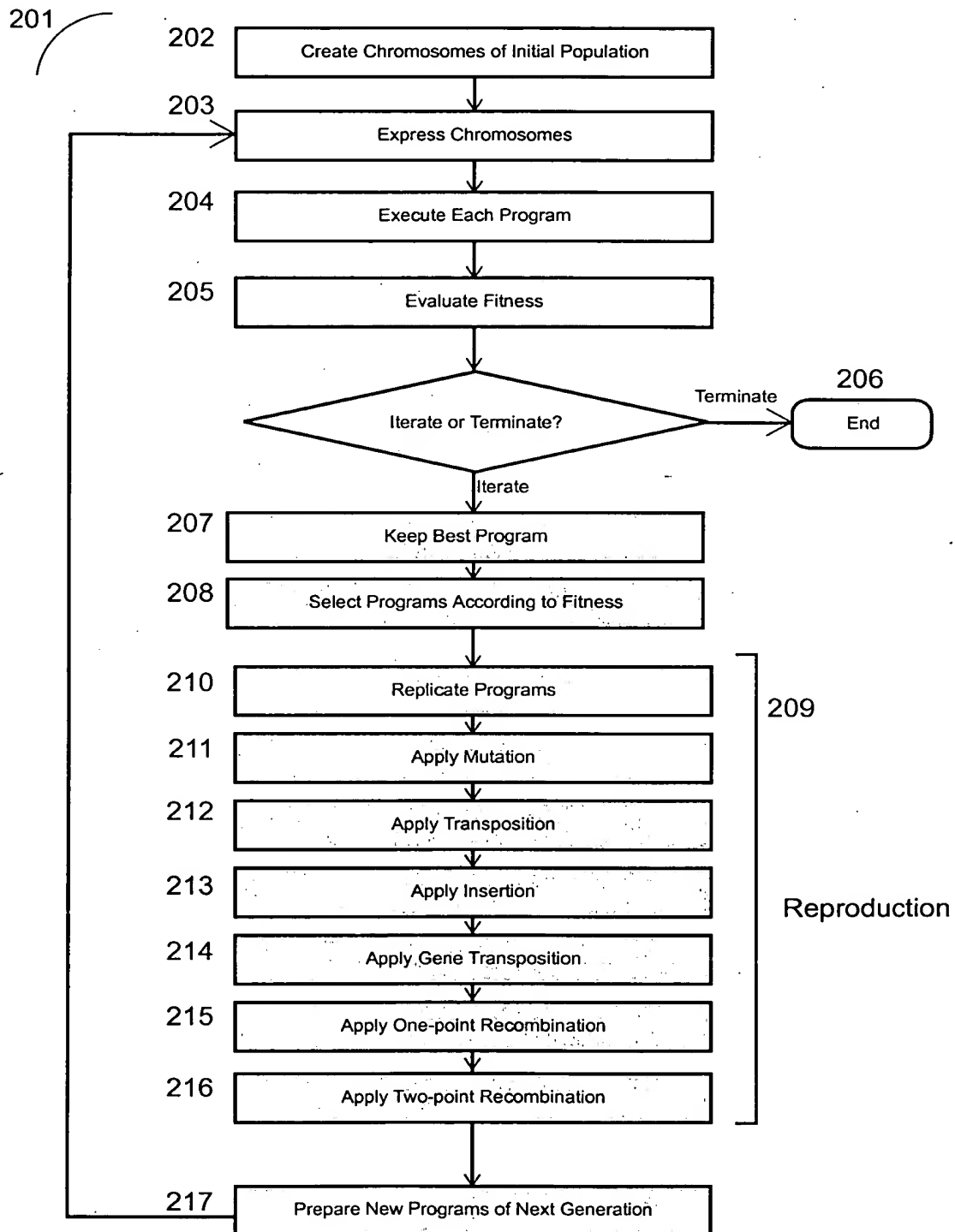
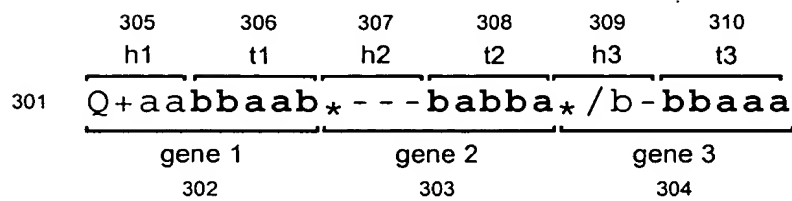
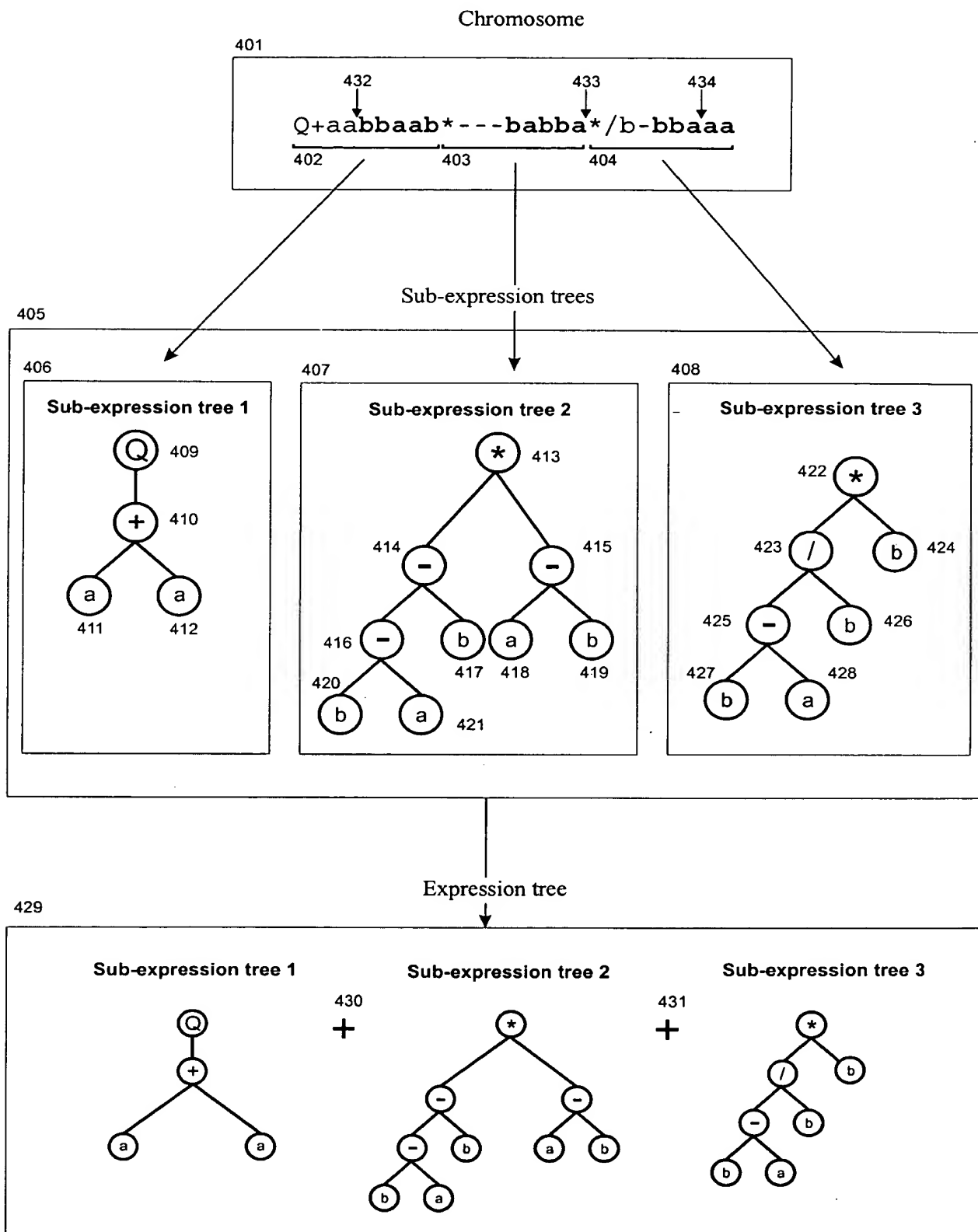


FIG 3



109070" 28266360

FIG 4



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FIG 5

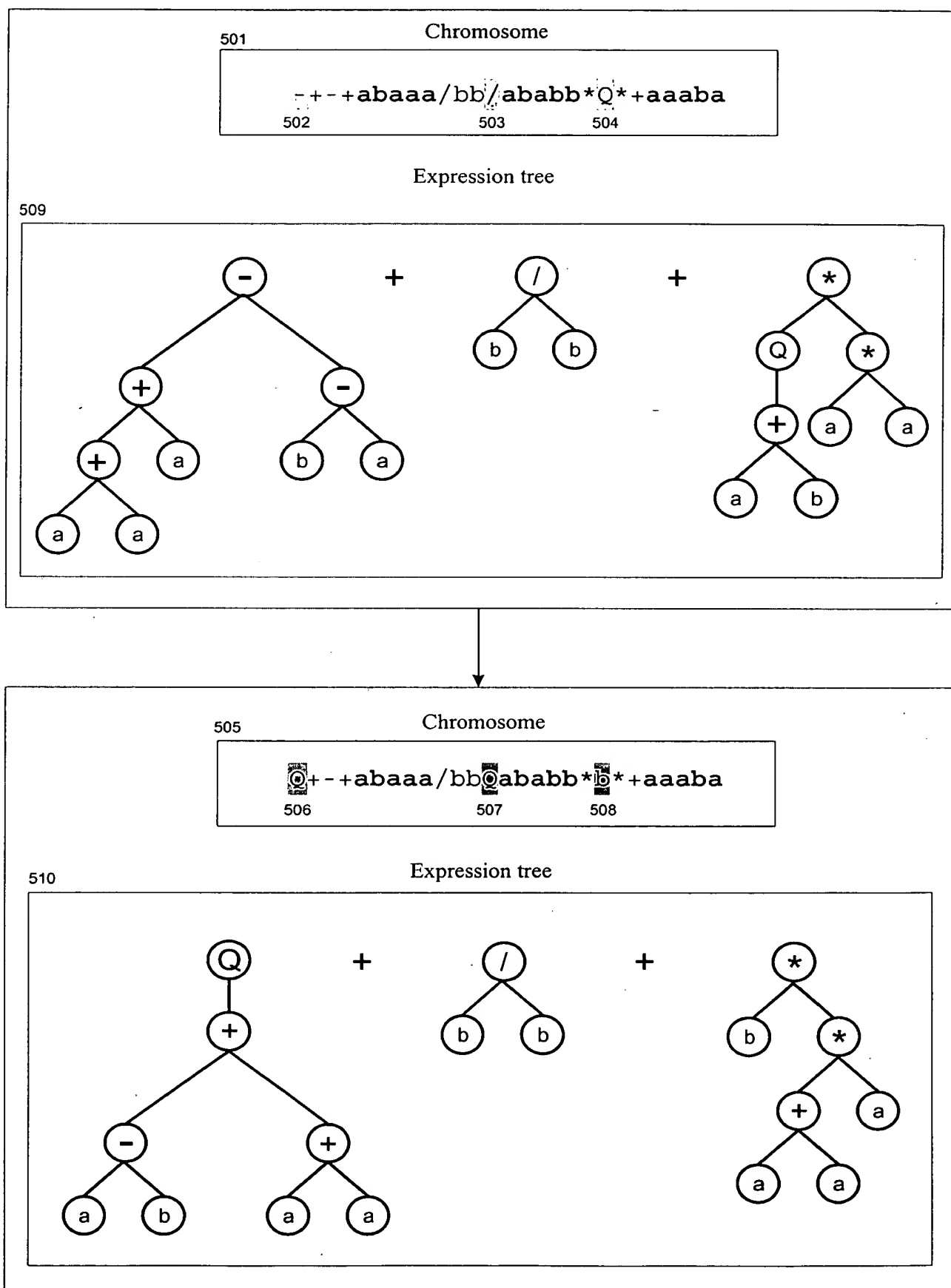


FIG 6

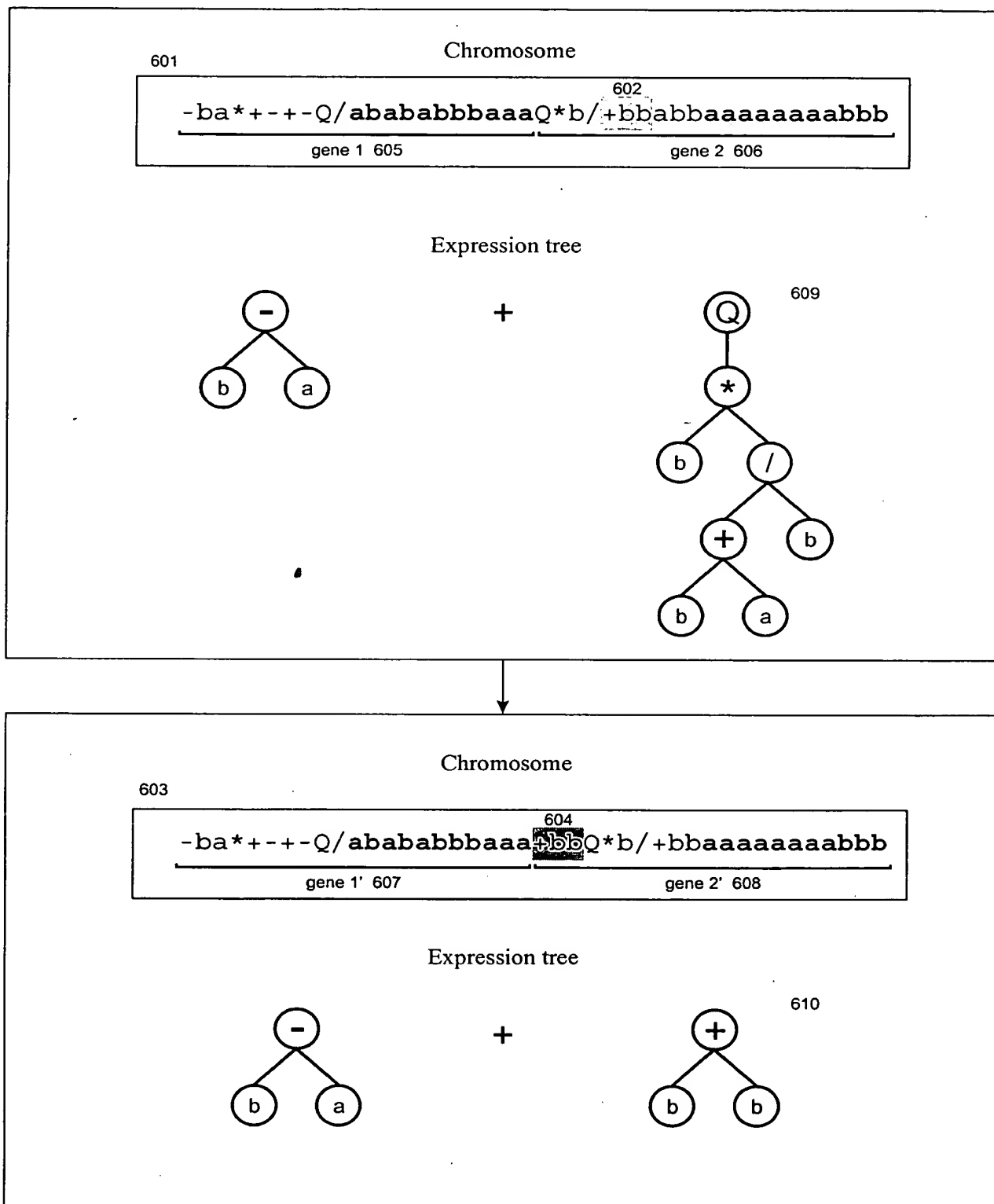


FIG 7

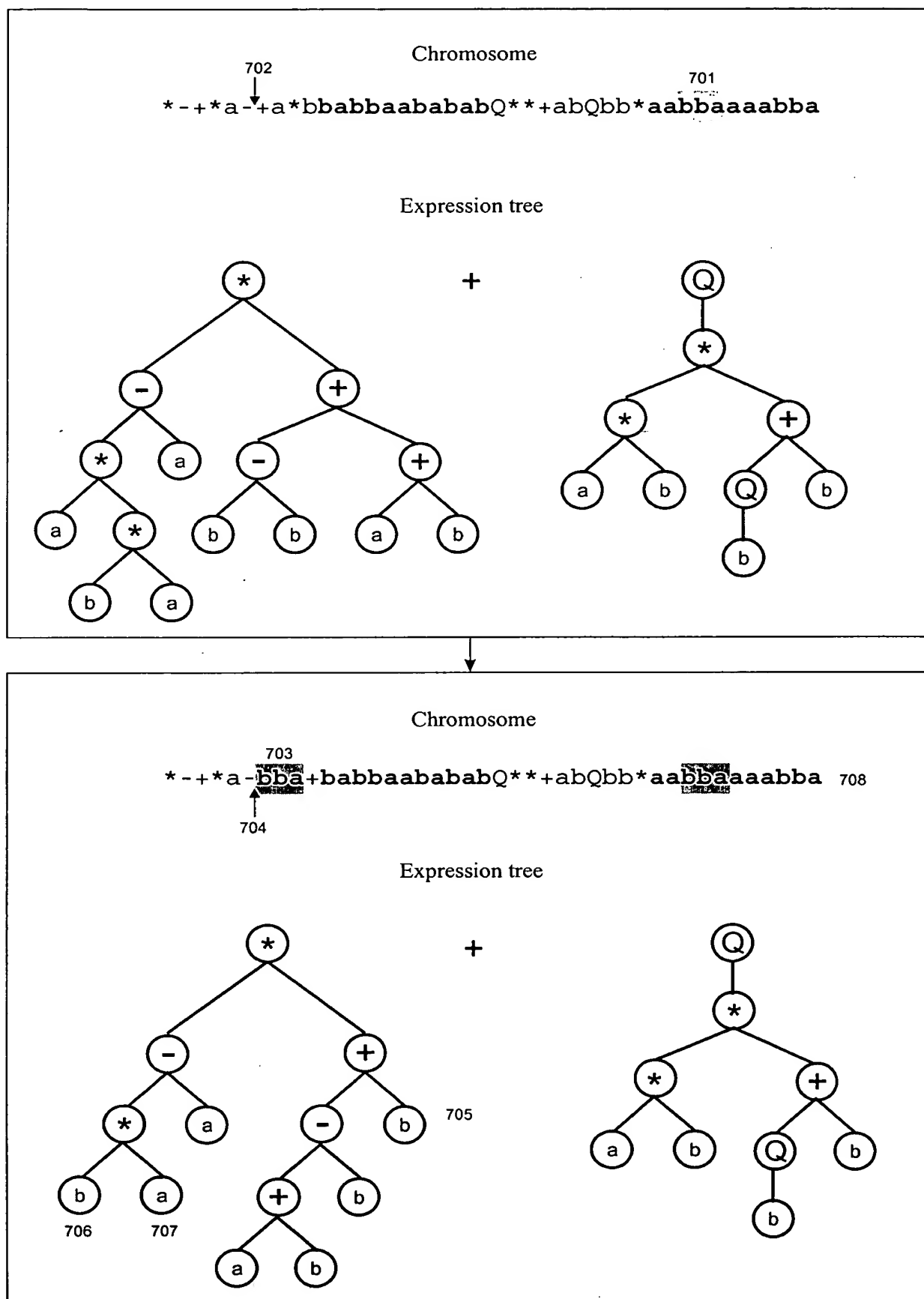
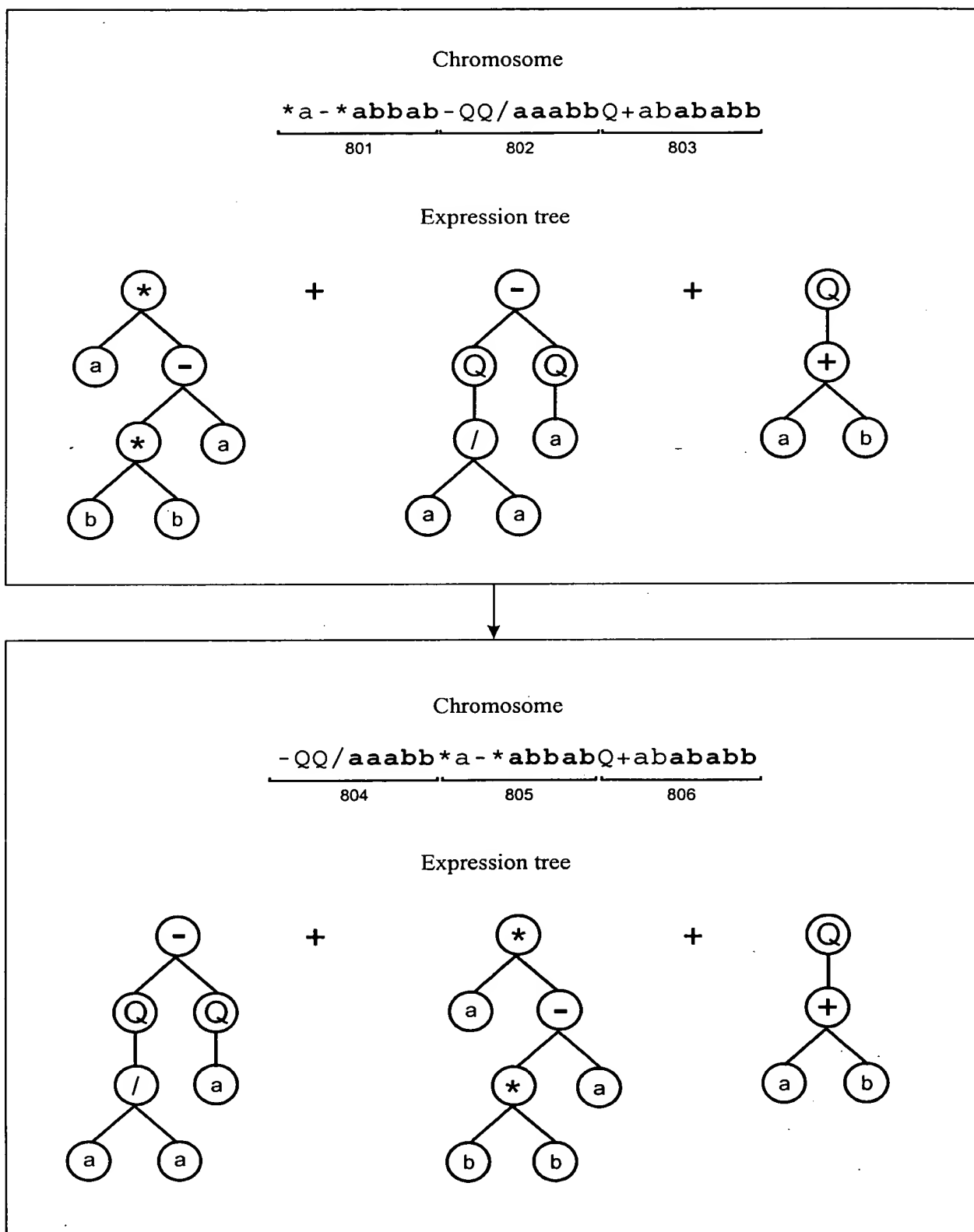


FIG 8



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FIG 9

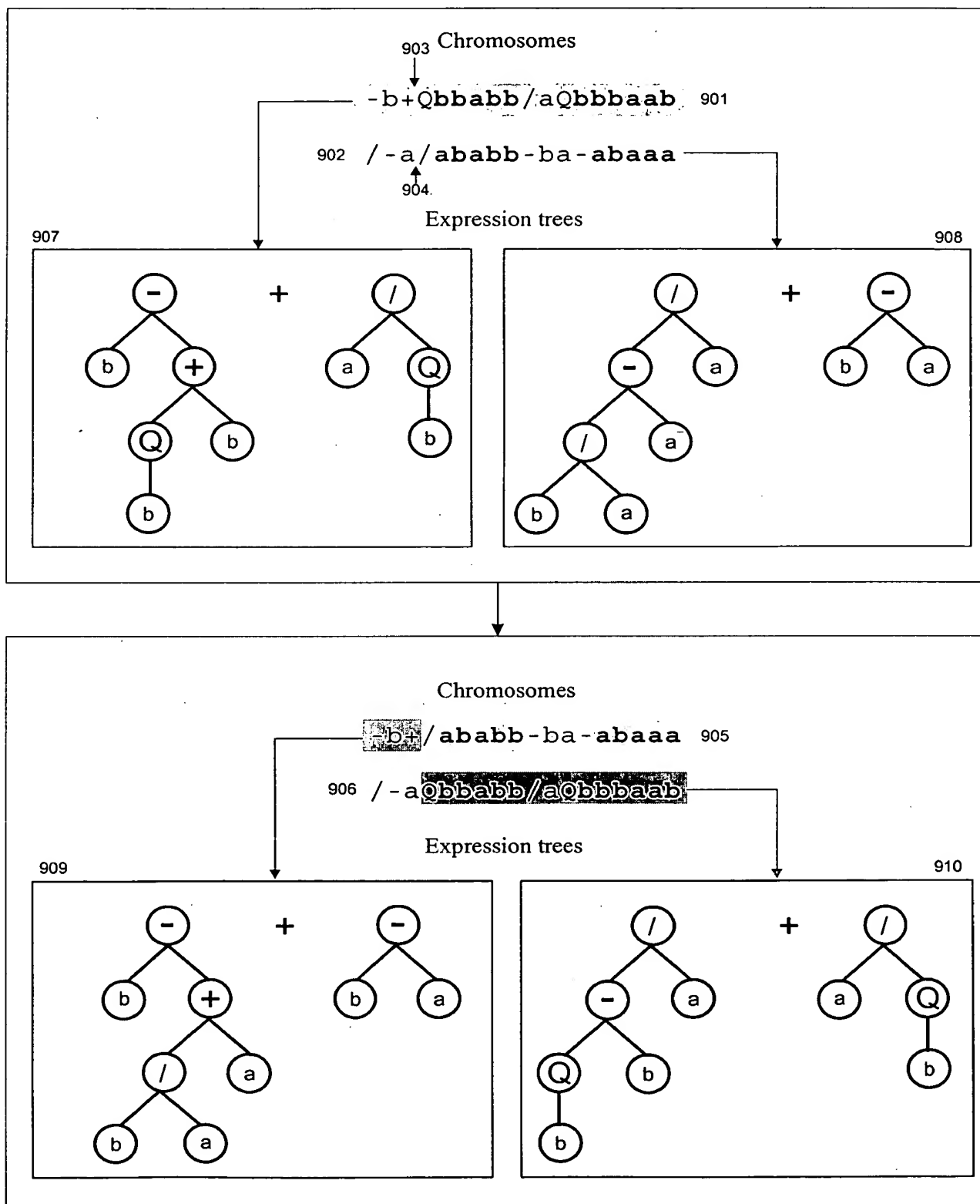
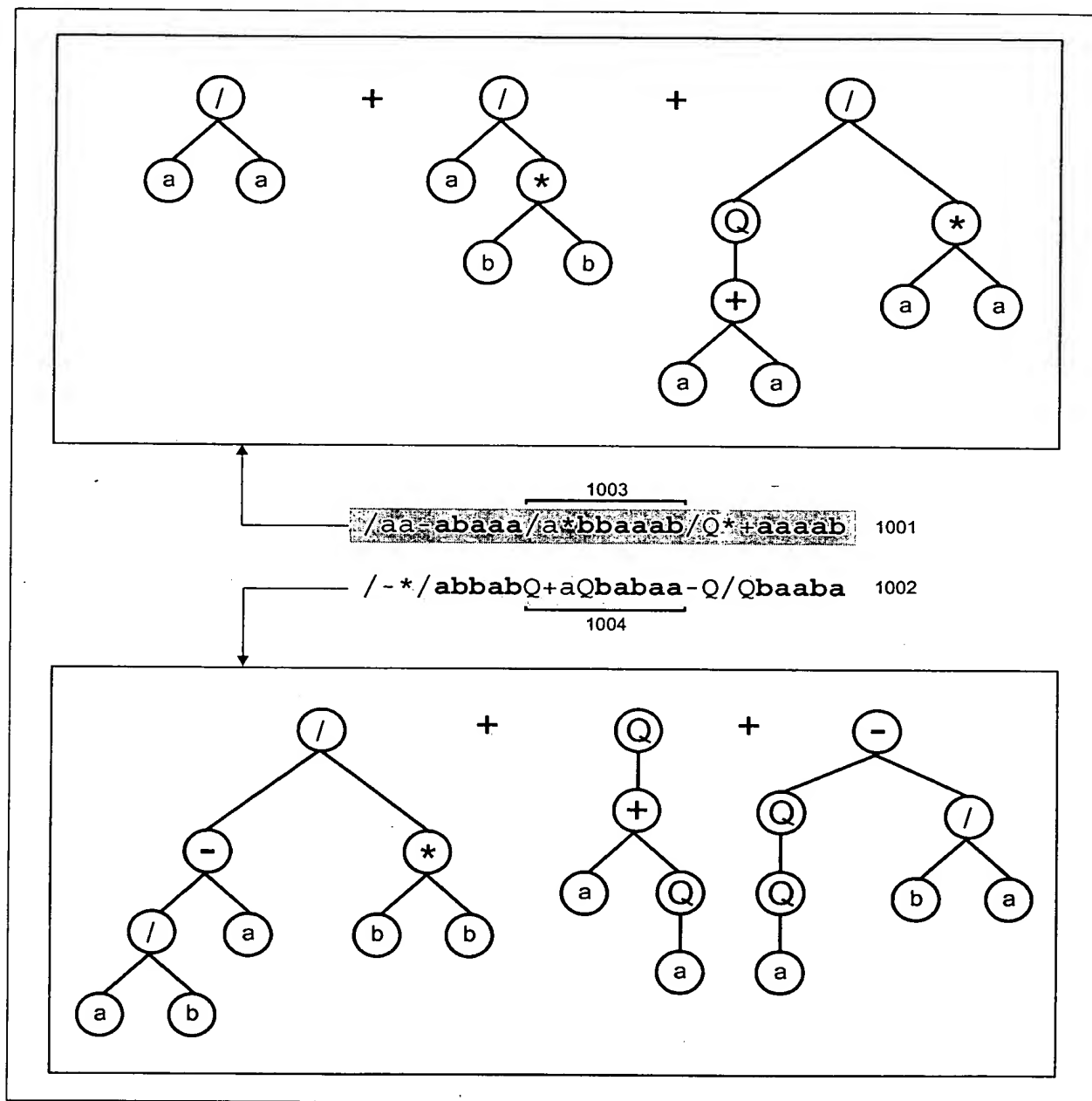
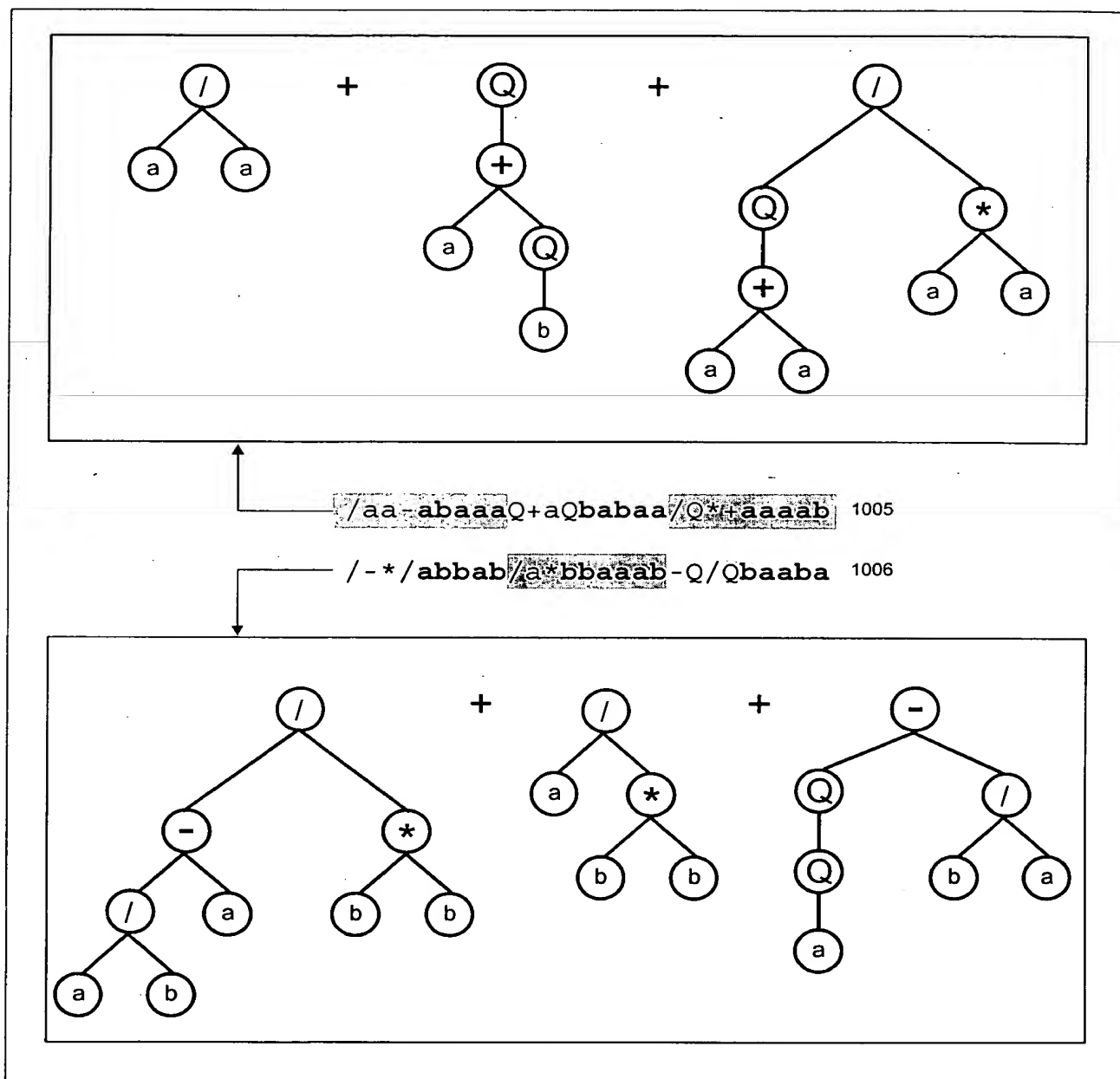


FIG 10A



09699282-070601

FIG 10B



09699282.070601

FIG 11

1101	Chromosomes	Fitness
	//*/-aaaaaa----+aaaaaa*++*+aaaaaa*+++aaaaaa-[0] = 0	
	//+//aaaaaa+/*+/aaaaaa*-a-aaaaaa-a**+aaaaaa-[1] = 0	
	+a*+aaaaaa+---+aaaaaa*---aaaaaa*++*+aaaaaa-[2] = 73.35578	
	+*a*-aaaaaa/+a/aaaaaa-/+**+aaaaaa**/-aaaaaa-[3] = 0	
	/+/*+aaaaaa/a/+aaaaaa+/aa+aaaaaa*/-/aaaaaa-[4] = 26.6697	
	++/-aaaaaa/-*/aaaaaa*++*+aaaaaa/a*a-aaaaaa-[5] = 0	
	++//aaaaaa-a*a+aaaaaa-/*//aaaaaa/++/*+aaaaaa-[6] = 25.44238	
	--+aaaaaa+a**+aaaaaa-a***+aaaaaa+/-*+aaaaaa-[7] = 0	
	-*a+-aaaaaa*a**+aaaaaa+*-a-aaaaaa//++aaaaaa-[8] = 22.67557	
	/+--+aaaaaa*a/*+aaaaaa/aa*+aaaaaa-*/a-aaaaaa-[9] = 0	
	+a/+aaaaaa++/-aaaaaa*+/*//aaaaaa-a-aaaaaa-[10] = 35.0658	
	-+a-*aaaaaa*++*/aaaaaa-+/-aaaaaa*a/+aaaaaa-[11] = 97.6903	
	/aa**+aaaaaa*+//aaaaaa/a**+aaaaaa+***+aaaaaa-[12] = 45.73774	
	-a-aaaaaa+/*+aaaaaa*-+*+aaaaaa--a-aaaaaa-[13] = 0	
	++*/-aaaaaa-a/a+aaaaaa*/-/aaaaaa/+--+aaaaaa-[14] = 0	
	++**//aaaaaa*/*//aaaaaa/a-aaaaaa--++*+aaaaaa-[15] = 0	
	/aa--aaaaaa-+*-/aaaaaa+**a/aaaaaa-/a+aaaaaa-[16] = 7.7575	
	++*-aaaaaa+*+-aaaaaa+a-+aaaaaa/a*-aaaaaa-[17] = 0	
	+++aaaaaa-/+-aaaaaa-a/a+aaaaaa*+*-aaaaaa-[18] = 0	
	+a-+*aaaaaa/a/+aaaaaa/*+/-aaaaaa*/a*/aaaaaa-[19] = 0	
	--a+-aaaaaa*a/a+aaaaaa+*//aaaaaa*a+/-aaaaaa-[20] = 21.5497	
	/+++*aaaaaa+ta+/aaaaaa*+--aaaaaa/+a+aaaaaa-[21] = 18.06512	
	/+aa-aaaaaa+//+aaaaaa*a+/-aaaaaa-*/-aaaaaa-[22] = 17.4636	
	/-/++aaaaaa/-+*+aaaaaa/a/-*+aaaaaa+--+aaaaaa-[23] = 0	
	++*-aaaaaa/*a-*aaaaaa/-+aaaaaa+/-*+aaaaaa-[24] = 27.9458	
	-/---aaaaaa-a*a+aaaaaa++++-aaaaaa-/a+aaaaaa-[25] = 0	
	+---aaaaaa/+/aaaaaa-a/a*+aaaaaa+*-a/aaaaaa-[26] = 18.2736	
	-*+a+aaaaaa/-/+aaaaaa*a*a+aaaaaa/-/a-aaaaaa-[27] = 80.0881	
	/-++-aaaaaa*+/-/aaaaaa/-+*+aaaaaa/-*+aaaaaa-[28] = 0	
	+-*//aaaaaa-*--+aaaaaa/a/+aaaaaa*a+/-aaaaaa-[29] = 31.31912	

Chromosome number

109070" 28265860

FIG 12

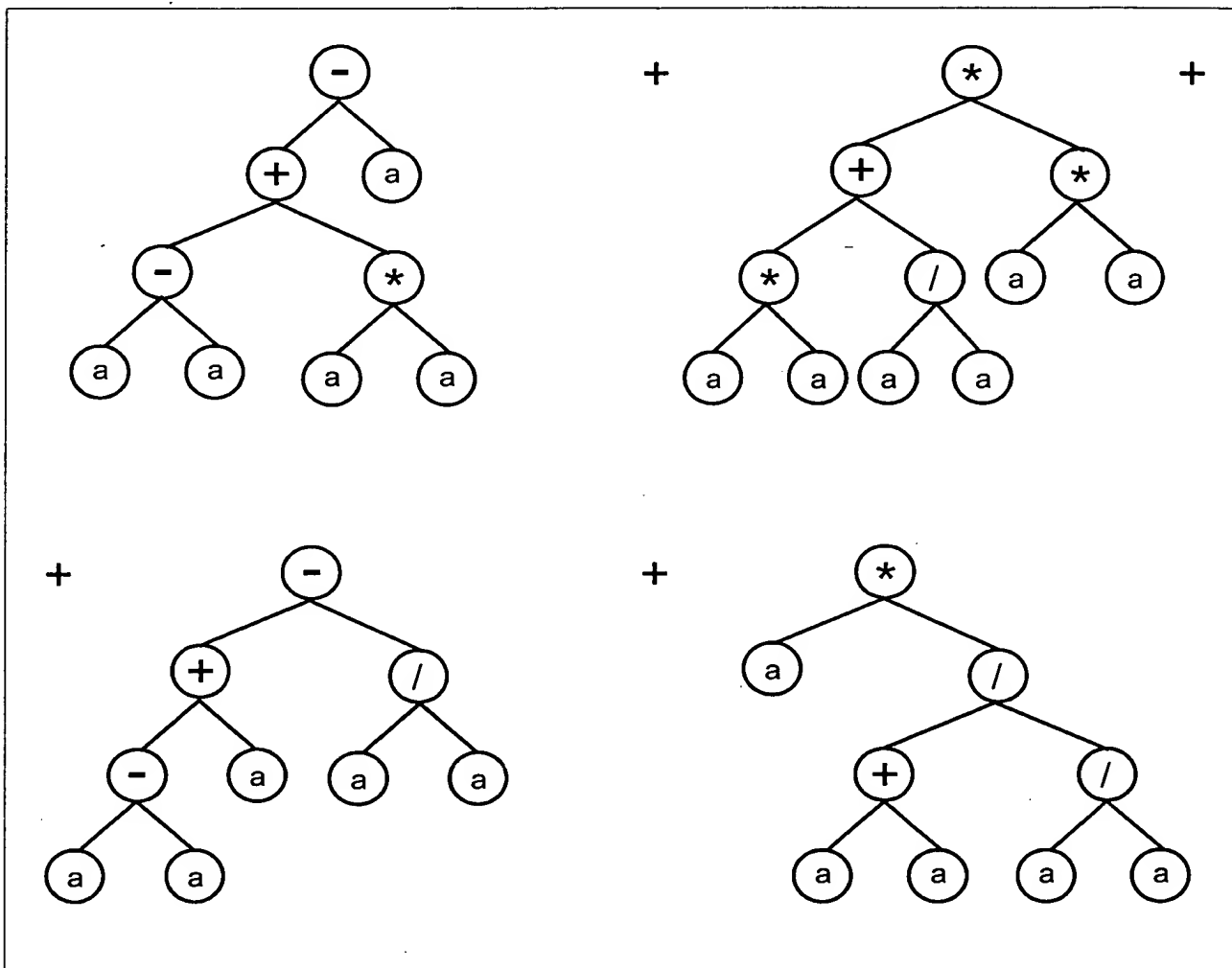
Chromosome

1201

-+a-*aaaaaa*+**/aaaaaa-+/-aaaaaaa*a/+ /aaaaaa

Expression tree

1202



Mathematical expression

1203

$$y = (a^2 - a) + (a^4 + a^2) + (a - 1) + (2a^2) = a^4 + 4a^2 - 1$$

FIG 13

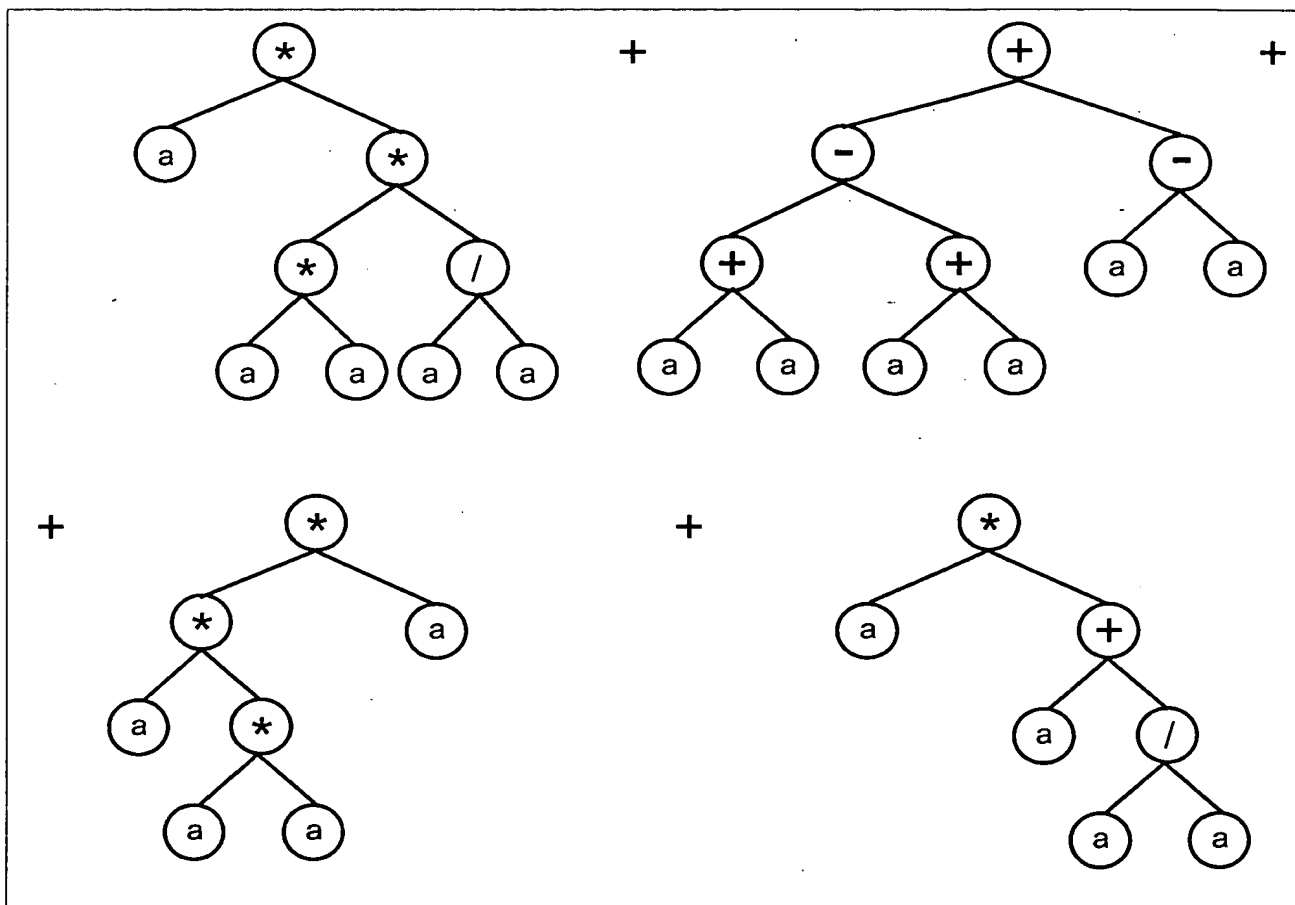
Chromosome

1301

*a** / aaaaaa+ - - + + aaaaaa * * a a * aaaaaa * a + a / aaaaaa

Expression tree

1302



Mathematical expression

1303

$$y = (a^3) + (0) + (a^4) + (a^2 + a) = a^4 + a^3 + a^2 + a$$

FIG 14

	Present Invention	Genetic Programming
G	50	51
P	30	500
C	10	20
P _s	1	0.35
R _z	1	11
F _z	15,000	5,610,000

109020" 28266860

Fitness cases' stacks

1503	Chromosomes	Fitness
	ApAAutputCuRuputptAttCtptuu- [0]	= 1
	ARRpttutpAAupupuupNCRNuttuu- [1]	= 0
	CCRApttttCAPNuptppRNAAttup- [2]	= 1
	ANpNttuptCARptutuuNRpAttuu- [3]	= 1
	ARCRtpptuRuuAppptpAttuptup- [4]	= 1
	ApuApuuutAARCutupuACNptpppu- [5]	= 0
	RARuputppCACApptupRRCNttutu- [6]	= 0
	AtAuppppuCuAtppptuNACAAttpp- [7]	= 1
	NtNAuputpACutppptuCuCRptppu- [8]	= 0
	NtANpptutAuRptpppuRpNAutupu- [9]	= 1
	AuututtuRptRptttuRAARutupt- [10]	= 0
	CpNRtuuupCCCnpupptRptCuptuu- [11]	= 2
	RCNAuptutCACTutuupNRtNptput- [12]	= 1
	AApNuuttpANCuptutuRCAutputp- [13]	= 0
	CtCututtuCAAAutptuANRNuttpt- [14]	= 0
	CAApptutCatNutppuAtpAtutut- [15]	= 1
	NpAAuppupAAAuptpuuAttRtputt- [16]	= 1
	AAARttuuuNAARtppuuAutuutptp- [17]	= 1
	ApRAutptNNAAppppuActRptuup- [18]	= 0
	AAApppputRNACupptpACNttuptu- [19]	= 0
	CpRNppppuACANttutNAAAutput- [20]	= 2
	AtNaututtAuptttuupARRCtuppp- [21]	= 0
	CAAAtputuAtANptpupAAptpuut- [22]	= 1
	ARNRtuuupApAtttputApRNupuut- [23]	= 0
	RtNNtpuppCtAuuuppuCAANpuutu- [24]	= 0
	RCAtuupttAutAptutpAAAtttuu- [25]	= 0
	RtAuputAAAptututRpRpptpuu- [26]	= 1
	CpAAtputuCCpNpttutAuRppupt- [27]	= 2
	AAARtpupuRuAAttuptCAuuppuuu- [28]	= 2
	RuAAputtuRACNuupptAuRppuupp- [29]	= 2

Chromosome number

FIG 16

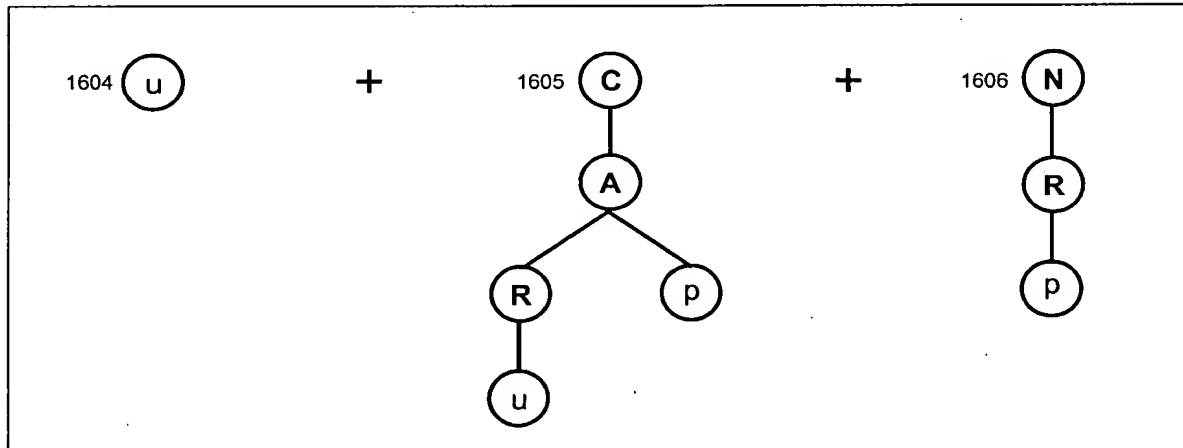
Fitness cases' stacks

1601
rilasnvu#-0
rls#####-1
anruievl-2
nr#####-3
viaslre##-4
ievlanru#-5
uenari###-6 — 1602
neai#####-7
li#####-8
#####-9

1603 Chromosome

uNpNttuptCARpuutupNRpCtutut

Expression tree



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T09040" 28266860

FIG 17

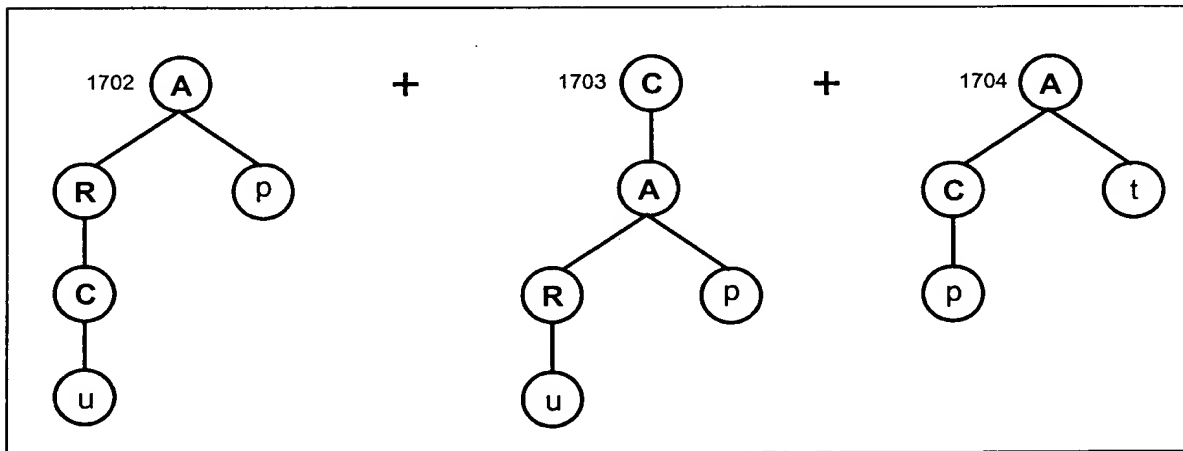
Fitness cases' stacks

s#####-0
 vulnsiaer-1
 iuvr#####-2
 riev#####-3
 ui#####-4
 isunrl###-5
 uniav####-6
 lireav###-7
 ni#####-8
 #####-9

1701 Chromosome

ARpCuututCARpuuuupACTptpuut

Expression tree



1701 1702 1703 1704

FIG 18

Fitness cases' stacks

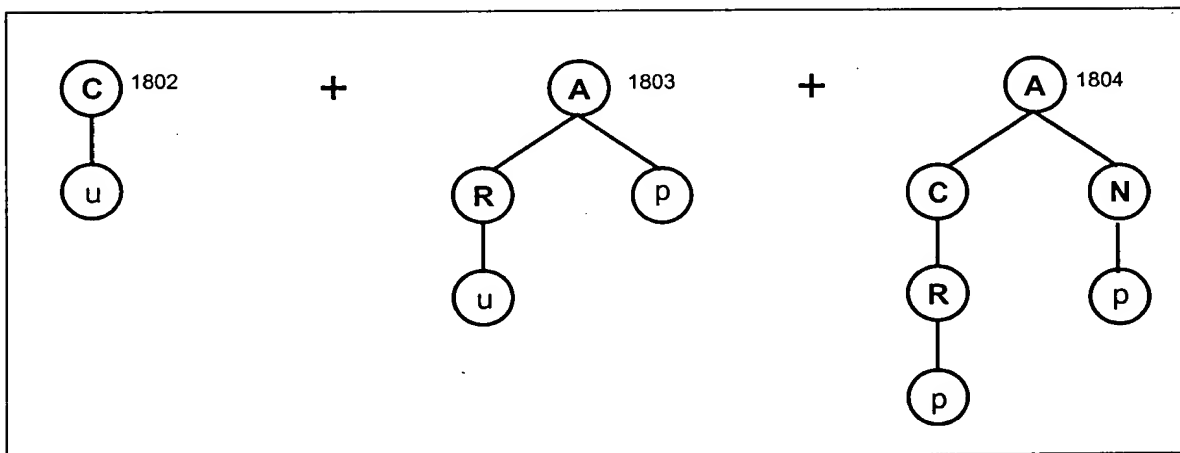
avnurle##-0
 vsrui####-1
 uerlvsnai-2
 saelnu###-3
 linv####-4
 sivnrlaeu-5
 vulrsaine-6
 esla#####-7
 vnarlsei#-8
 #####-9

1801

Chromosome

CutputuptARpuuuttpACNRppuuu

Expression tree



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FIG 19

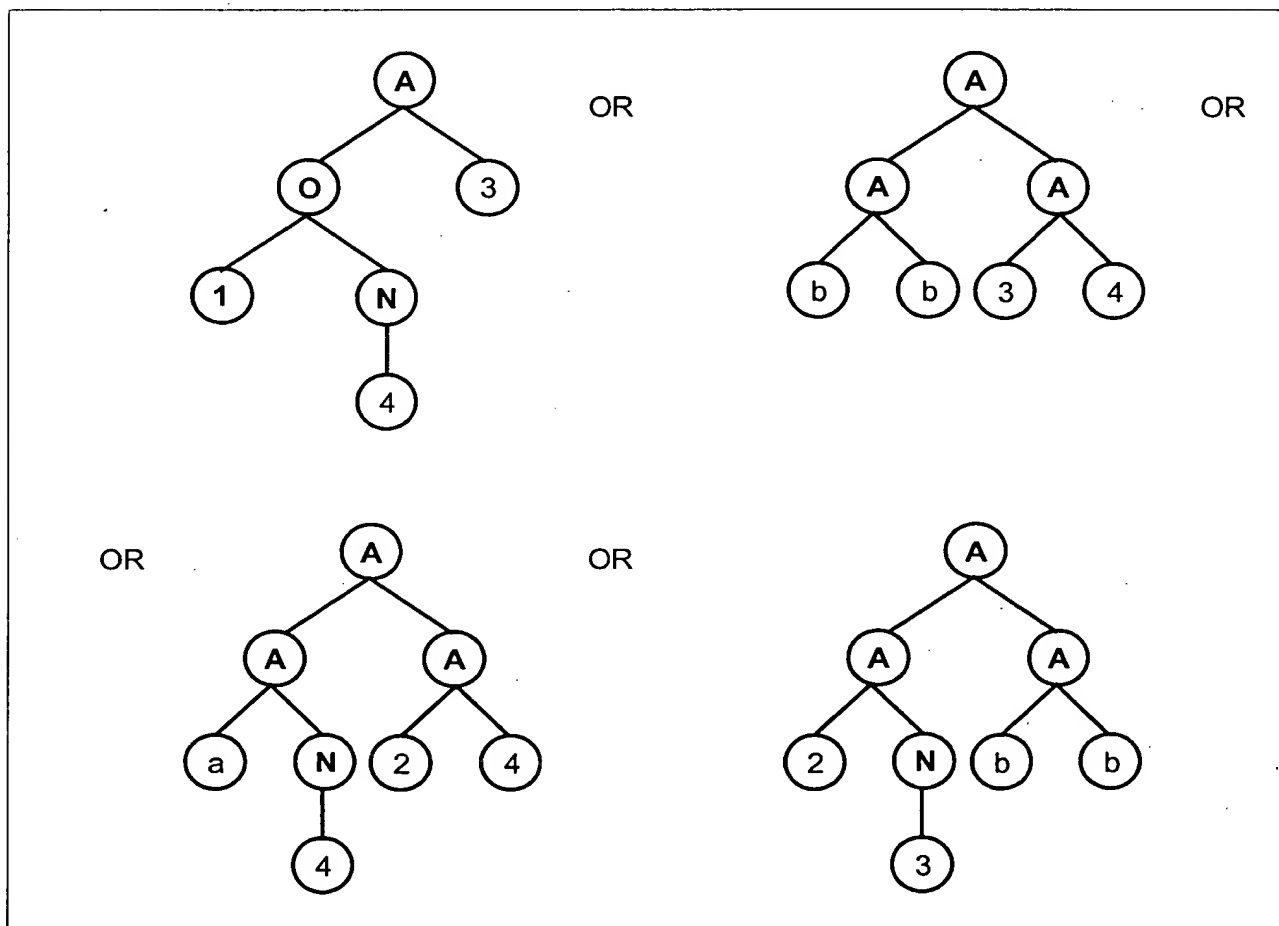
	Present Invention	Genetic Programming
G	100	51
P	30	500
C	10	167
P _s	0.70	0.767
R _z	4	4
F _z	120,000	17,034,000

109020" 23266860

FIG 20

2001 Chromosome Fitness
 AO31N4322a4AAAbb342444AAa244bb3AAA2Nbb3a1b = 44

2002 Expression tree



FO9020"28266860

2102

```

graph TD
    A((A)) --> 1((1))
    A --> A2((A))
    A2 --> 2((2))
    A2 --> O((O))
    O --> b((b))
    O --> 4((4))
  
```

OR

```

graph TD
    A((A)) --- a((a))
    A --- O1((O))
    O1 --- 31((3))
    O1 --- O2((O))
    O2 --- 1((1))
    O2 --- 32((3))
  
```

OR

OR

OR

```

graph TD
    A((A)) --> a((a))
    A --> O((O))
    O --> 3((3))
    O --> b((b))
  
```

```

graph TD
    A((A)) --> O((O))
    A --> 2((2))
    O --> 1((1))
    O --> A2((A))
    A2 --> b1((b))
    A2 --> b2((b))
  
```

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FIG 22

2201 Chromosome Fitness
 AOOOAa21b3aAaO33133311AaN31bb4321AON1Abb4a3b = 216

2202

Expression tree

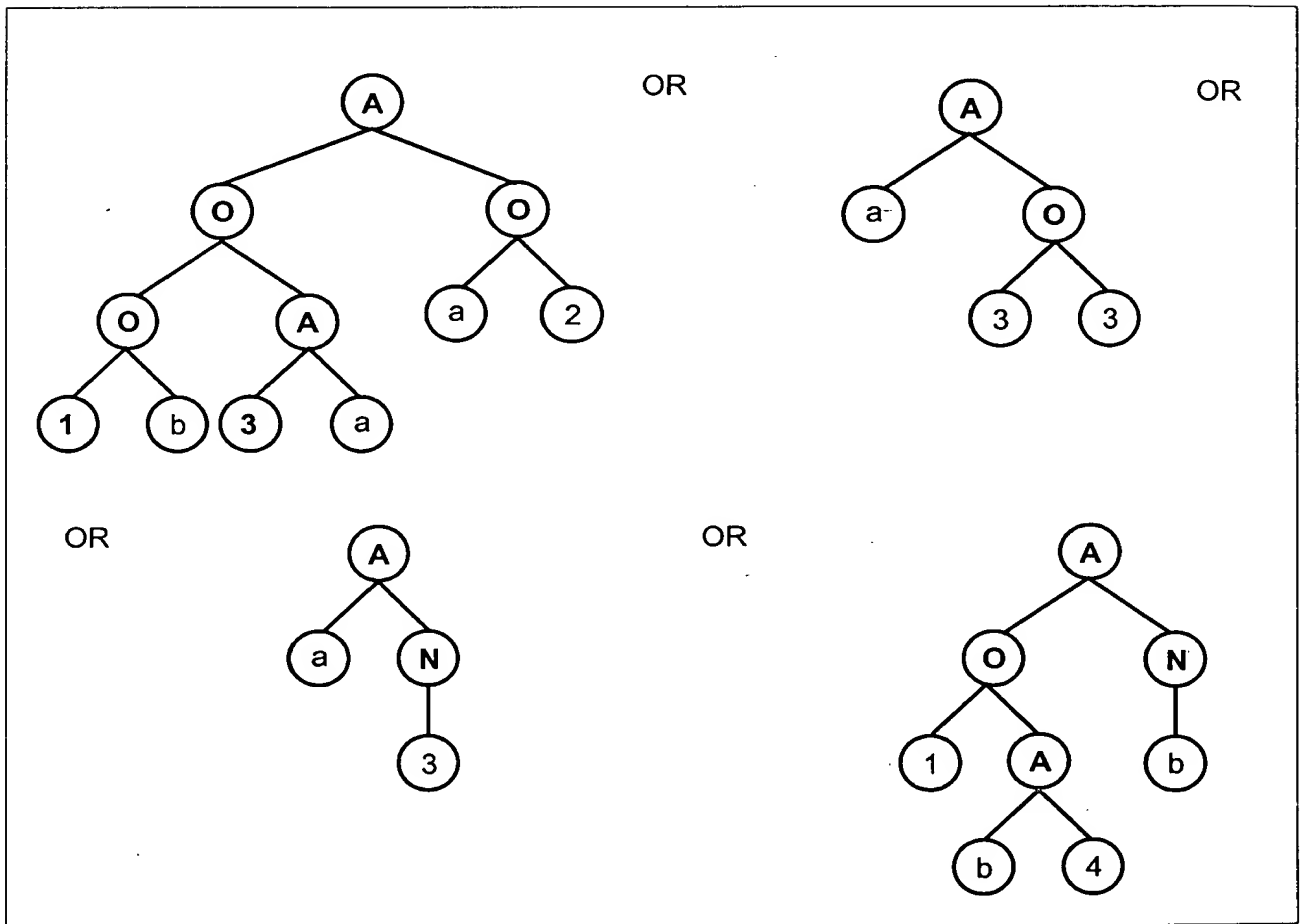
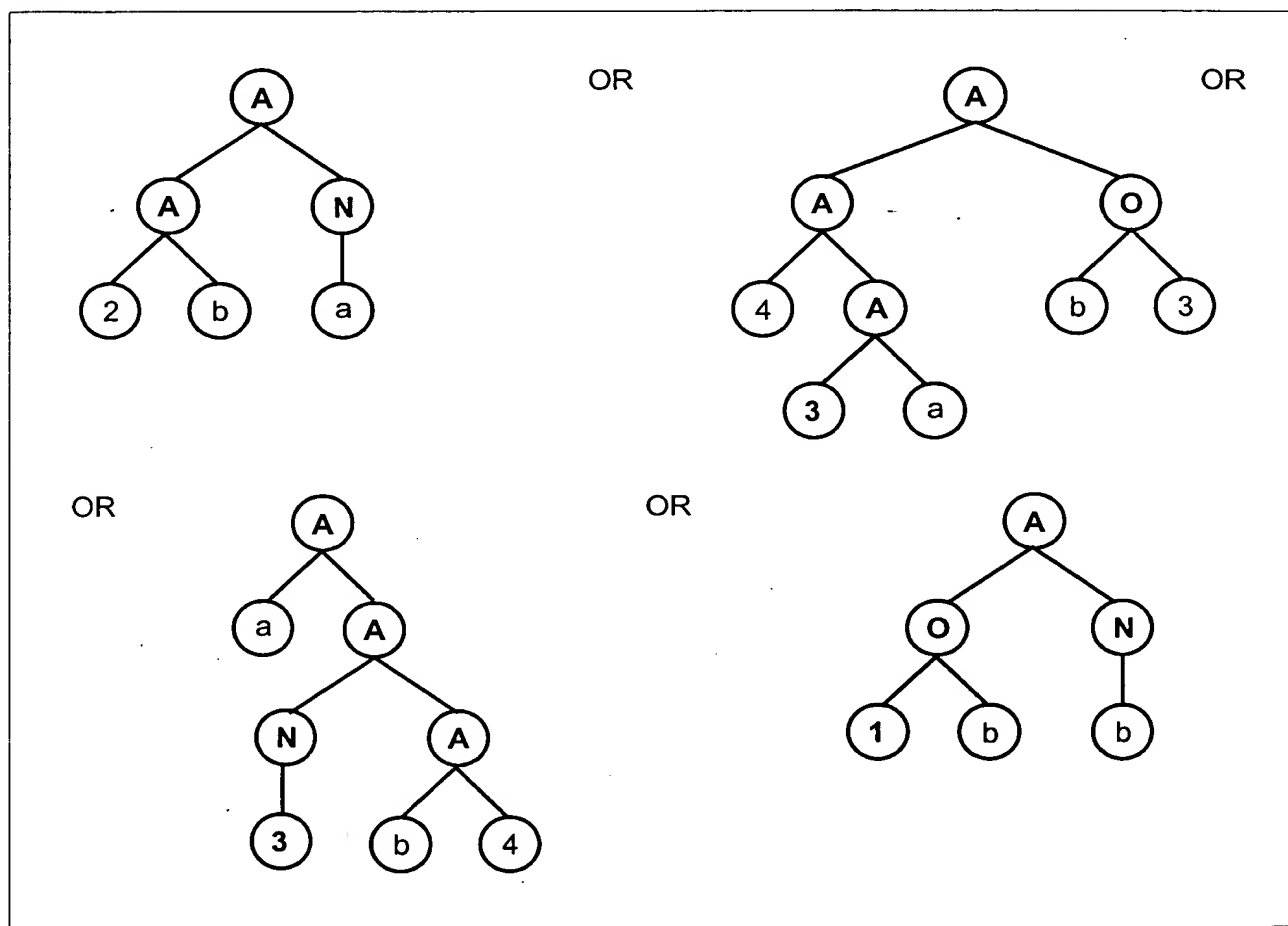


FIG 23

2301 Chromosome Fitness
 AAN2baa4b2bAAO4Ab33a31AaANA3b4312AON1bb1b233 = 310

2302 Expression tree



OR

Fitness

Expression tree

